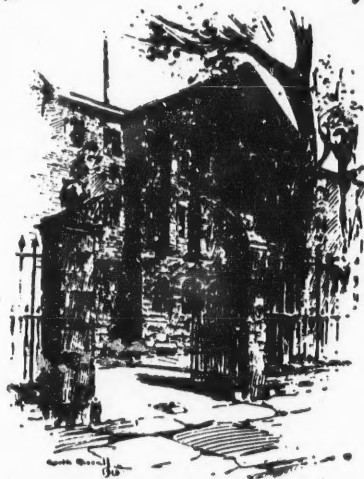


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NOTES ON NOVA SCOTIA PIT WATERS.

By EDWIN GILPIN, A.M., F.G.S., INSPECTOR OF MINES.

THE composition, sources, and effects of the hidden springs of the earth are as yet so little known, and the field for investigation is so wide and varied, that the time has not yet arrived for reliable deductions; but it may be expected that at some future day the composition of mineral springs and the waters cut by boreholes, &c., may be brought into the service of man, and furnish valuable information about the proximity of mineral deposits and strata.

So far as the writer is aware, but four analyses have as yet been made of Nova Scotia pit waters. Two of these are of waters from the Pictou coal district, and two from the Cape Breton district; they, however, represent fairly the characteristics of the waters of the two districts.

At the Blockhouse Colliery, Cape Breton, the pit water has a corrosive effect on the ironwork exposed to its action. The following analysis was made in the laboratory of the Canadian Geological Survey, 1872-73:—

SUSPENDED MATTER.						
Sulphate of iron ...	...	...	...	...	...	1510
IN SOLUTION.						
Iron (aspersalt) ...	...	...	...	...	...	2426
Iron (asprotosalt) ...	...	...	...	...	...	1168
Manganese ...	...	...	...	...	...	0078
Aluminium ...	...	...	...	...	...	0420
Calcium ...	...	...	...	...	...	1498
Magnesium ...	...	...	...	...	...	0618
Potassium ...	...	...	...	...	...	0134
Sodium ...	...	...	...	...	...	1884
Silica ...	...	...	...	...	...	0116
Sulphuric acid ...	...	...	...	...	...	14808
Chloric ...	...	...	...	...	...	4100
Phosphoric acid ...	...	...	...	...	...	traces
Organic matter ...	...	...	...	...	...	2844
Total constituents in 1,000 parts ...						30094

Water, yellowish-brown colour, acid reaction, and styptic taste.

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622.5
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The Blockhouse Seam immediately overlies the Gowrie Seam, worked by Messrs. Archibald. In Vol. XXVI., p. 56, of the Transactions, there is an interesting account of the difficulties that gentleman met with in overcoming the destructive effects of the water found in their pit. There is no analysis of the water from the Gowrie Mine, but, from its appearance and action, there is no doubt but that the analysis given above will also indicate its composition.

At several other collieries in the Cape Breton district similar corrosive powers appear in the pit waters, and have caused much annoyance to those engaged in conducting mining operations.

Direct-acting force pumps are very generally employed, and frequently require replacement of the iron working parts by compositions similar to that used at the Gowrie, such as brass, babbitt metal, and lignum vitæ. No doubt the heat induced by the steam would tend to increase this corrosive tendency, but the portability of these pumps, and the general adoption of slope winnings, cause their retention. When, through ignorance or a false economy, these waters are introduced into the colliery boilers, an immediate and energetic corrosion takes place. The boilers used in Cape Breton, with a few exceptions, are cylindrical egg-ended, externally fired. The action of the water is shown by cutting the rivet heads—severe pitting, a planing away of some of the plates over a space of several square inches, and generally a deposit of hard scale on the lower back end plates.

A scum-collector, invented by Mr. W. M. Rumble, Mechanical Superintendent, Cape Breton Coal Co., has been found to materially prevent the destructive effect of these waters at the Emery Colliery. The description of it is from the Report of the Inspector of Mines for 1877:—"It may be described generally to consist of a two-inch pipe leading from near the back end of the boiler up to an 18-gallon receiver, placed above the boiler and nearly over the fire bridge; from the receiver pass two pipes, one to the open and the other directly downwards through the shell to low-water line, where it branches into two transversely-placed bell mouths, each having a diameter equal to the difference between high and low-water in the boiler. The circuit being made by the necessary valves, a current of water flows through the system in a contrary direction to the order of the above description. Then as the strongest ebullition occurs where the bell mouths are placed, the scum in the water is thrown to the surface and passes up into the receiver where it settles, and from which it is periodically blown out through the second pipe."

The pit water from the Gardener Colliery has developed all the above injurious qualities in a marked manner. The following analysis of this

4812

water, made by the writer some time ago, shows a composition similar to that of the Blockhouse water:—

Iron sulphate	2.750
Potassium sulphate	.185
Calcium carbonate	.736
Magnesium carbonate	.025
Sodium chloride	.960
Alumina	trace
Silica	.225
Total in 1,000 parts	4.831

Water, clear with bluish shade; after standing, deposited reddish sediment; acid reaction, and highly styptic taste.

This water also exerted a corrosive action on the force pumps and the wrought-iron rising columns. The action on the latter was mitigated by a coating of oxide of iron deposited by the water. As this coating was nearly one-half inch thick in a 5-inch pipe, the partial protection thus afforded was attended with a lessened area through the pipe.

Passing to the Pictou coal-field there is a class of waters of a totally different character and of a comparatively innocuous nature. The following analysis of the pit water of the Vale Colliery, made by the writer a short while ago, is as follows:—

Iron and alumina	traces
Magnesium carbonate	"
Calcium carbonate	"
Sodium chloride	1.452
*Sodium carbonate	7.509
Magnesium sulphate	.100
Calcium sulphate... ..	.514
Potassium	traces
Silicious matter	.190
Organic matter	trace
Total in 1,000 parts	9.765

Water, clear and colourless; at first it gave no reaction, but after boiling became alkaline.

* The percentage of sodium carbonate appeared so large that the determination was repeated, and the former result confirmed; the percentage given is an average of both determinations.

This water has been used a little as a boiler feed, and has not shown any injurious effects.

The second analysis of Pictou pit water now given is one of the water from the Nova Scotia Colliery, situated at the western extremity of the

district, made by Dr. H. How, King's College, Windsor, N.S., giving the following results:—

Silica	...	...	...	...	...	...	...	...	460
Calcium carbonate	...	...	...	...	...	...	...	...	10·590
Magnesium carbonate	...	...	...	...	...	...	...	...	3·570
Iron carbonate	...	...	...	...	...	...	...	...	traces
Sodium chloride	...	...	...	...	...	...	...	...	1·170
Potassium sulphate	...	...	...	...	...	...	...	...	1·580
Sodium sulphate	...	...	...	...	...	...	...	...	2·500
Sodium carbonate	...	...	...	...	...	...	...	...	3·350
Phosphoric acid	...	...	...	...	...	...	...	...	none
Organic matter	...	...	...	...	...	...	...	...	traces
									23·20

Water, bright and clear; no odour, slightly acid; after boiling gave alkaline reactions. Calculated in grains to the imperial gallon.

These waters have been used to some extent mixed with surface water, with no markedly injurious effects.

On comparing the Pictou and Cape Breton pit waters it will be at once seen that the latter contain very large quantities of iron sulphates, and the former large percentages of alkaline carbonates. These waters all differ from any of the Canadian pre-carboniferous waters, which are fully described by Dr. Sterry Hunt in Sir William Logan's "Geology of Canada," 1863. The Canadian waters, arising from comparatively undisturbed measures, present constituents derived from limestones, dolomites, argillaceous sediments, and feldspathic rocks, which admit of their division into six classes. The number of Nova Scotia pit waters analysed is too small to admit of any deductions which can be considered reliable. But there are a few points, which may to some extent account for these widely-divergent results. In considering the composition of these pit waters found in workings of moderate depths, it may be assumed that they are accumulated partly from surface water filtering downwards, and partly from water rising from lower measures by hydrostatic pressure through the strata, or by means of faults.

The strata containing the Cape Breton coals are largely composed of sandstones, many of which hold numerous disseminated crystals of iron sulphurets, while the shales which predominate in Pictou County are comparatively free from this ingredient. This and the larger percentage of iron pyrites and organic compounds of sulphur in the Cape Breton coals may account for the large amounts of iron sulphates the former contain. The preponderance of sodium chloride in the Pictou pit water may be explained by the fact that on the southern edge of the district,

whence the waters analysed were taken, the Lower Carboniferous limestones and gypsums come against the coal-measures with very little intervening millstone grit, and the heavy faults bounding the district would allow the admission of their waters to the workings. In Cape Breton, on the other hand, the coal-measures are comparatively undisturbed, and a great thickness of millstone grit must intervene between them and the marine (Lower Carboniferous) limestones. In both districts limestone is almost entirely wanting in the coal-measures.

The following analysis of a Cape Breton Lower Carboniferous water, from the Little Narrows of the Bras d'Or Lake, made by the analyst to the Geological Survey, 1873, is given for comparison :—

Sodium chloride...	...	...	...	...	...	50.6881
Potassium chloride	...	...	...	...	...	.1942
Magnesium chloride	...	...	...	...	...	.1592
Calcium sulphate	...	...	...	...	...	5.6810
Alumina...	...	...	...	...	...	traces
Silica	...	...	...	...	...	"
Ferric oxide suspended, originally present, probably as						}
ferrous carbonate	...	...	...	...	...	
Total in 1,000 parts	...	...	...	...	...	56.7279

This fairly represents the composition of the Lower Carboniferous waters, although in cases where they rise from highly gypseous portions of these measures, the calcium sulphate sometimes predominates.

This derivation of the sodium chloride from the marine limestones in the case of the Pictou waters may be supported by the fact that at the Vale Colliery, where the Lower Carboniferous measures are a comparatively short distance away, the cleats of the coal are frequently coated with films of selenite up to one-quarter of an inch in thickness; and it will also be observed that the water from this mine contains a considerable amount of calcium sulphate. The unusually large percentage of sodium carbonate present in the waters from the Vale Colliery does not at first seem easily accounted for, unless it owes its origin to the argillaceous shales which were formed from the granites and silurian slates of the hills lying to the south of the district.

The comparatively small amounts of magnesium salts present in all the Nova Scotia pit waters may perhaps be owing to the fact that this mineral is not abundant in the province—an average of twenty analyses of Lower Carboniferous limestones giving but .75 per cent. of magnesium carbonate.